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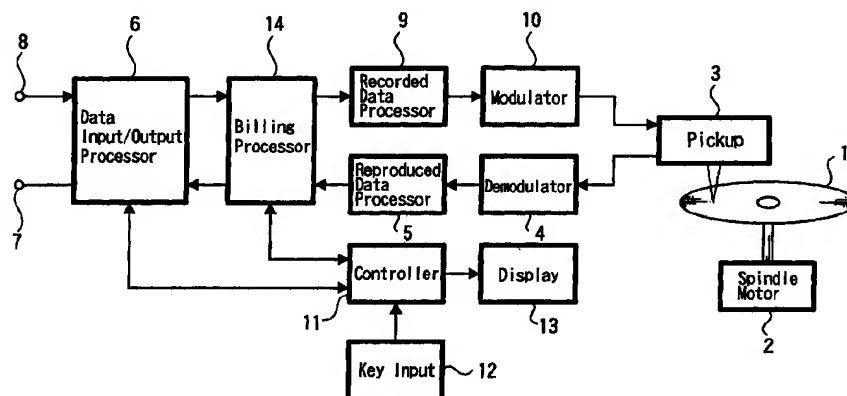
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(54) Recording medium, recording method and recording apparatus

(57) The recording medium (1) having the write-once recording area in which any information can be recorded and the recorded information cannot be rewritten is employed. A partial area of the write-once recording area is provided with the billing information recording area in which the billing information is

sequentially recorded once, whereby it is possible to effectively prevent the wrong use when carrying out the off-line processing to bill by using the recording medium.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a recording medium such as an optical disk or the like recordable of information, a recording method using this recording medium and a recording apparatus using the same, and particularly to a technique using a recording medium which has a write-once recording area that is nonrewritable.

Description of the Related Art

[0002] Systems of billing transaction include those which access a management center of billing information by on-line telephone or computer network, etc. to transact for billing and those which make the billing information to be stored in a magnetic recording medium such as a telephone card or IC card, etc. to transact for billing in an off-line way.

[0003] Those which process for billing in the off-line way are already widespread as a prepaid card, etc. because they are simple in system structure and superior in mobility as compared with the on-line system.

[0004] Each of these off-line systems using the prepaid card, etc. employs a rewritable recording medium to process for billing, so that there is some fear that the billing information is falsified and actually considerable damage is also caused. For this reason, counter-measures have been proposed, such that the billing information recorded in the recording medium is enciphered or a structure is incorporated that if anyone attempts to analyze recorded information by force, the information is then destroyed. However, the actual situation is that no effect has been obtained because of problems of its cost and convenience and a vicious spiral between the counter measure and wrong users is caused on account of rapid progress of deciphering technique.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to prevent effectively the illegal use when carrying out the off-line processing to bill.

[0006] In order to achieve this object, the present invention employs for processing to bill a recording medium having the write-once recording area in which any information can be recorded, but the recorded information cannot be rewritten, and having, a billing information recording area in which the billing information is sequentially once recorded on a partial area of the write-once recording area.

[0007] The write-once recording area of the recording medium makes it impossible to erase any information written into that, and therefore providing the billing infor-

mation recording area in the write-once recording area makes difficult of the wrong use of billing information.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Figure 1 is a structural diagram showing an example of the structure of a recording/reproducing apparatus for the recording medium according to an embodiment of the present invention;

Figures 2A to 2D are each an explanatory diagram showing an example of data structure on the recording medium according to an embodiment of the present invention;

Figure 3 is an explanatory diagram showing an example of data structure (an example of data structure of a packet by the track-at-once method) on the recording medium according to an embodiment of the present invention;

Figure 4 is an explanatory diagram showing an example of data structure (an example of data structure of a packet by the variable length packet method) on the recording medium according to an embodiment of the present invention;

Figure 5 is an explanatory diagram showing an example of data structure (an example of data structure of a packet by the fixed length packet method) on the recording medium according to an embodiment of the invention; and

Figure 6 is an explanatory diagram showing an example of data structure (an example of data structure of link blocks) on the recording medium according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] An embodiment of the present invention will be described below with reference to the accompanying drawings.

[0010] In the present embodiment, the present invention is applied to a recording medium having a write-once recording area in which recorded information cannot be rewritten. In this case, an optical disk referred to as a CD-R is used as the recording medium having the write-once recording area. First of all, a recording format of the CD-R will be described. This format is such that described in a standard document called an orange book.

[0011] Data structure of the CD-R will be described below. Figure 2 shows the data structure on the CD-R. Referring to Figure 2A, in the innermost peripheral portion close to a disk center 100 is provided a PCA (Power Calibration Area) 101 indicating a light quantity adjustment area. The PCA 101 has a test area for adjusting the light quantity of an optical beam during

recording and a count area for recording the state of use of the test area.

[0012] Adjacent to the PCA 101 in the outer peripheral direction from the disk center 100 is provided a PMA (Program Memory Area) 102 indicating a program area. On this PMA 102 is recorded the state of use of the program area of CD-R. Specifically, start address information and end address information of data recorded at a track unit are recorded in a manner to repeat a plurality of times.

[0013] Adjacent to the PMA area in the outer peripheral direction from the disk center are provided a plurality of sessions 103, 104 and 105. The respective sessions 103, 104, 105 have in the outer peripheral direction from the disk center 100 lead-in areas 106, 109, 112, program areas 107, 110, 113 and lead-out areas 108, 111, 114. In the lead-in areas 106, 109, 112 are recorded data of index information of signals recorded in the program areas 107, 110, 113 as TOC (Table of Contents) 115, 116, 117 in a manner to repeat a plurality of times.

[0014] Each session is recorded sequentially toward the outer periphery direction from the disk center 100. For example, the session 3 of 105 becomes recordable only when the lead-in and lead-out areas 109, 111 in the session 2 of 104 have been recorded to complete the session 2. At the same time, the session 2 of 104 becomes impossible of additional recording.

[0015] Specific contents of the TOCs 115, 116, 117 are as follows. The TOCs 115, 116, 117 will begin at starting times of the lead-in areas 106, 109, 112, respectively. Within TOCs 115, 116, 117 each item is repeated three times. The completed TOCs 115, 116, 117 are repeated continuously within the lead-in areas 106, 109, 112.

[0016] On the program areas 107, 110, 113 are recorded audio data and the like. Data structure of the session 103 is shown in Figure 2B. The program area 107 is given track numbers TNOs depending on the number of recorded data, as shown in Figure 2B. In this example, three data tracks 118, 119, 120 are provided in one session. Each of tracks 118, 119, 120 is made up of two areas distinguished by an index. Data structure of the track 118 is shown in Figure 2C. The track 118 has, as shown in Figure 2C, a TD (Track Descriptor) 121 for giving track information and a packet 123 which is a data unit smaller than the track 118. Within the TD 121 also is recorded the same information in a manner to repeat a plurality of times.

[0017] Specific contents of the TD 121 are as follows. The TD contains information on the track attribute of user data 122. The track attribute means three kinds of track recording method, i.e. a track-at-once method, a fixed length packet method and a variable length packet method as well as a packet size and so on. To write into the TD the same information is repeated for two or more seconds within this area.

[0018] Data structure of the packet 123 is shown in

Figure 2D. At the head of the packet 123 is provided a link block area 124. This link block area 124 forms a connecting portion to a previous packet together with a run-in area 125. This example shows the fixed length packet method in which a length of the packet is fixed. Between the run-in area 125 and a run-out area 126 is sandwiched a user data area 127. These run-in area 125 and run-out area 126 are guard areas on which no data can be recorded.

[0019] Next, the recording method will be described. Figure 3 shows the data structure of packet according to the track-at-once method. An area whose index is "00" is a TD 160. In the TD 160 recorded is information indicating that a packet 162 is recorded using the track-at-once method. An area whose index is "01" is a recording area of user data 161. Link blocks 163 and 164 are buffer zones.

[0020] Figure 4 shows the data structure of packet according to the variable length method. An area whose index is "00" is a TD 170. In the TD 170 recorded is information indicating that a packet 172 is recorded using the variable length method. An area whose index is "01" is a recording area of user data 171. The packet 172 has an arbitrary number of blocks equal to or more than eight blocks (user data is one block). Link blocks 173 and 174 are buffer zones.

[0021] Figure 5 shows the data structure of packet according to the fixed length packet method. An area whose index is "00" is a TD 180. In the TD 180 there are recorded information indicating that a packet 182 is recorded using the fixed length method as well as a number of blocks in the packet length. The packet length means the number of blocks of user data within a single packet. An area whose index is "01" is a recording area of user data 181. The user data 181 is comprised of the number of blocks in the packet length which is recorded in the TD 180. Link blocks 183 and 184 are buffer zones.

[0022] Figure 6 shows the data structure of link blocks. The link blocks are comprised of seven blocks in total, one block of a link block area 191, four blocks of a run-in area 192 and two blocks of a run-out area 193. This data structure of link blocks shows that the link blocks of the current packet are the link block area 191 and the run-in area 192, and the link blocks of the packet immediately before the current packet by one are the run-out area 193.

[0023] As concerns the method of recording on the track, any one method of the track-at-once method shown in Figure 3, the variable length packet method shown in Figure 4, and the fixed length packet method can be selected at each track. The selected method is described in the TD. Moreover, the lead-in area and lead-out area are handled as one track and the recording method on these areas is limited only to the track-at-once method.

[0024] As one of methods for writing once, i.e. for recording additional data within the program area of the

CD-R constructed in this manner, there is a track write-once operation in which data is written once by the track unit.

[0025] In the case of performing the track write-once operation, data in the PMA area is read out to detect an area where data is not recorded within the program area on the optical disk, i.e. a nonrecorded area, on which nonrecorded area data is written once in a unit of track.

[0026] Furthermore, there is a case where data is written once in a unit of packet which is a unit of data smaller than the track unit. The data write-once operation carried out in the packet unit is also called an intra-track write-once operation. In this case, information on the start address and end address of the track is previously recorded in the PMA area so that the track may be formed by an arbitrary number of packets. However, when the last track is in the open state, that is, the end address of track is not decided, the end address of track is regarded as the last end of user data recordable area of the disk and is not recorded in the PMA. In the intra-track write-once operation, data is continuously recorded in sequence from the first packet in the track. After this data recording operation is interrupted, data is again recorded from an address next to that of the last recorded data.

[0027] In the present embodiment, the CD-R having the structure as described above is used for the processing to record the billing information. Specifically, a part of the write-once area of CD-R being the recording medium recordable (writable once) of data is defined as the billing information recording area, in which area the billing information is recorded

[0028] The billing information is recorded, for example, using the above described fixed length packet recording method. First of all, a data vacant area (non-recorded area) for processing to bill is defined on the disk. Specifically, for example, a predetermined track is reserved (i.e. track information is registered in the PMA area, but in fact the track is not written) and that track is defined as the billing information recording area so that a size of the area for processing to bill may be fixed. Alternatively, by utilizing the last end of recordable area of the disk, that last end area may be defined as the fixed billing information recording area. However, the billing information recording area need not necessarily be a continuous area on the medium (on the disk).

[0029] Suppose now that, for example, eighty thousand blocks of vacant areas are set on the disk for the billing information recording area. These eighty thousand blocks correspond, according to the CD-R format, to an area for recording a digital audio signal of frames for seventeen minutes forty-six seconds and fifty. Assuming that a fixed packet whose packet length is one block is recorded on this area, because the total number of packets is $80000/(1 + 7) = 10000$, that area is set as such that ten thousand packets can be recorded. So, if one packet is compared to one billing unit, e.g. one yen to assume a recorded portion of the billing

information recording area to be a spent amount of money and a nonrecorded portion thereof to be the balance, it will then be possible to process for billing of ten thousand yen.

[0030] Figure 1 shows an example of the structure of recording/reproducing apparatus for a CD-R which is provided with the billing information recording area in this way. A disk (CD-R) 1, in which the billing information recording area is set, is driven to rotate by a spindle motor 2, thus causing an optical pickup 3 to reproduce from each track and record onto each track. The reproduced signal by the optical pickup 3 from the disk is subjected to a demodulation processing for reproduction by a demodulation processor 4 and then processed to extract the reproduced data by a reproduced data processor 5. The extracted reproduced data is then processed to be output by a data input/output processor 6 and is then output from an output terminal 7 as data of predetermined format.

[0031] Incoming data on an input terminal 8 is determined by the data input/output processor 6 that it is to be handled by this apparatus and then processed to be recorded by a recorded data processor 9. The processed data is further processed to be modulated for recording by a modulation processor 10 and the modulated signal is then supplied to the optical pickup 3 for processing to carry out the recording onto a target track.

[0032] In this connection, the reproduction processing and recording processing are arranged to be executed under the control of a controller 11 which is a system controller of this apparatus. To this controller 11 is connected a key input device 12, thus causing the controller 11 to execute processing based on user's key operation. Also, a display device 13 for displaying results processed by the controller 11 is connected thereto, thereby allowing various displays with numerals, characters and the like to be displayed under the control of controller 11. Furthermore, the controller 11 is arranged so that, when the optical disk 1 installed in this apparatus is such one as has the billing information recording area, it can control the processing to bill through a billing processor 14 which inputs and outputs specific billing data.

[0033] Where the CD-R having the billing information recording area is installed as the optical disk 1 to be installed in this recording/reproducing apparatus, the optical pickup 3 reproduces information on the billing information recording area under the control of controller 11 and from the recorded state of billing information recording area the balance established on the optical disk is decided through the billing processor 14, thus causing the display device 13 to display the balance, for example. Specifically, the controller 11 decides an area set for the billing information recording area through the billing processor 14 and reproduces the billing information recorded in the decided billing information recording area. The billing processor 14 measures the number of blocks recorded in the billing information recording

area and decides the balance from the number of blocks to make the display device 13 to display it using the controller 11.

[0034] When it is arranged, for example, that the eighty thousand blocks (ten thousand packets) are prepared for the billing information recording area to process for billing of ten thousand yen, as described above, if no information is recorded at all in this area, the balance is then determined to be ten thousand yen and if a number of recorded blocks are detected, the balance is then determined to be an amount of money which is obtained by subtracting the number of blocks in yen from ten thousand yen.

[0035] When a user confirms an amount of money displayed on the display device 13 and makes by the key input device 12 an operation to spend some amount of money of the balance, the controller 11 controls the billing processor 14 to allow the use of the apparatus for the input amount of money, causes the billing processor 14 to use the number of blocks corresponding to the spent amount of money on the billing information recording area of the optical disk 1 to record the information on spending the amount of money, and causes the display device 13 to display the balance. In this case, for example, log information relating to billing utilization is recorded on the billing information recording area. In other words, log information on the billing utilization such as "when, how much, what, and how is it purchased" is recorded. Alternatively, only a fact that the billing of that amount of money is carried out may simply be recorded.

[0036] By processing to bill in this way, it is possible to process for billing using the CD-R being the write-once medium in which the recorded information cannot be erased so as to prevent effectively the wrong use. Specifically, in case of the present example, "a size of non-recorded portion of the billing information recording area" of the disk is equal to "the balance" (or "a size of recorded portion of the billing information recording area" as equal to "the spent amount of money") and so it is impossible to reduce the spent amount of money because the recorded portion cannot be erased physically even though anyone tries to falsify the amount of money. Even if anyone tries to write something into the billing information recording area by force, only a reduction of the balance will thereby result, or only a loss will result. In short, it is physically impossible to make malicious falsification of the billing information.

[0037] By using the recording medium of the present example in this manner, it is possible to build up the billing processing system which enables the off-line processing at low cost without any special processing such as enciphering the billing information, making use of the physical property of irreversibility of the recording area of the medium.

[0038] In addition, the size (the number of blocks) of the billing information recording area need not be made corresponding directly to an amount of money. Instead,

for example, it may be arranged that the spent amount of money (or the balance) is recorded as data, e.g. on the user block of packet in the billing information recording area and then whenever money is spent, the spent amount of money is sequentially written. Even when processed in this way, because the already recorded portion cannot be erased, it is impossible to falsify the recorded portion. Even though new data in which the spent amount of money is wrongly reduced is written, because all the records remain in the billing information recording area on the medium, checking the records in turn will make it possible to easily detect that a wrong processing takes place.

[0039] Moreover, when the above described log information is recorded on the billing information recording area, the managing side of the billing system can grasp the use state of this system by each user by collecting the log information to analyze it later. Furthermore, by arranging to record such log information, instead of so-called prepaid system in which a payment of a certain amount of money is required at the stage when the recording medium is distributed to the user, it is possible to construct a system in which, after money was spent, a settlement of the amount of money is carried out at some stage based on the log information recorded on the billing information recording area of the medium.

[0040] In addition, the off-line billing system is generally weak at an illegal act in which recorded signals in the medium is whole transferred to another cheap available medium. However, in case of the write-once recording medium, it is impossible to transfer whole unless it is in a completely nonrecorded condition. Even if it is such a nonrecorded medium, by burying in advance special information only in the medium for billing and circulating it, the above illegal act can also be prevented.

[0041] Although, in the above description, the CD-R installed in recording/reproducing apparatus is used only for processing to bill, it may be arranged that information on contents forming objects of billing is beforehand recorded on the same recording medium so that the contents and billing information may simultaneously be provided to the user with a single sheet of medium. For example, if an enciphered application software is recorded on the first session of the disk and the second session of the same disk is defined as the billing information recording area, the processing to bill for the application software of the first session can be carried out by using that disk only.

[0042] In this case, if a so-called hybrid disk is employed that a "read-only portion" in which data is previously recorded by the so-called stamping process when manufacturing the disk and a "recordable once portion" used for the billing information recording area can both be intermingled on the same medium, it will then be possible to provide the software effectively and process the billing required when using the software. For example, if the first session is formed by the stamping process and the second session is formed as the

recordable once portion, it is possible to manufacture it at nearly the same manufacturing cost as an optical disk like a usual CD (compact disk), etc. and make mass production of the disk compatible with secure processing to bill.

[0043] Although, in the above described mode for carrying out the invention, the processing to bill is performed using the optical disk called the CD-R for the recording medium, other recording media may be used. In other words, if a recording medium has at least partially the recordable once area in which recorded data cannot be rewritten, any such recording medium can be used. Moreover, the recording medium need not be diskform in shape like the aforesaid CD-R. For example, a cardform optical recording medium may be employed. Additionally, a solid memory such as One Time ROM in which once recorded data cannot be altered may also be used for the recording medium.

[0044] The present invention is applicable to various billing processing systems to which the recording medium is utilized. It is applicable to various modes of billing system, e.g. not only for processing to bill for the use of pay software of computer as well as software of video program, audio program, etc. but also for processing to pay an audience fee of a pay channel by providing receivers for various broadcast such as satellite broadcast with a function to record/reproduce on or from the recording medium according to the present embodiment.

[0045] According to the recording medium of the first aspect of the present invention, the recording method which is applied to this recording medium of the sixth aspect of the present invention and the recording apparatus of the eleventh aspect of the present invention in which the recording medium is installed, by using the write-once recording area on the recording medium for the recording area of billing information, no information written into the write-once recording area can be erased physically, thus making difficult of the wrong use of billing information. Therefore, the off-line processing to bill using the recording medium becomes satisfactory one preventing effectively the wrong use by simply processing to write in turn the billing information.

[0046] According to the recording medium of the second aspect of the present invention, the recording method of the seventh aspect of the present invention which is applied to this recording medium, and the recording apparatus of the twelfth aspect of the present invention in which the recording medium is installed, because the billing information is such on the balance which reduces by the billing from the amount of money initially set up, such a wrong use that increase the balance will be difficult, thus enabling the wrong use to be effectively prevented.

[0047] According to the recording medium of the third aspect of the present invention, the recording method of the eighth aspect of the present invention which is applied to this recording medium, and the recording

apparatus of the thirteenth aspect of the present invention in which the recording medium is installed, because the billing information recording area is comprised of a predetermined number of blocks and the number of blocks on which the billing information is not yet recorded has a definite relation with the balance, the balance is readily decided and besides, when anyone tries to write some information into the billing information recording area on purpose to wrongly use, the balance will only reduce, which functions so as to prevent the wrong use as a result.

[0048] According to the recording medium of the fourth aspect of the present invention, the recording method of the ninth aspect of the present invention which is applied to this recording medium, and the recording apparatus of the fourteenth aspect of the present invention in which the recording medium is installed, because the recording medium has the contents information recording area in which information on contents forming an object of billing of the billing information is previously recorded, the processing to bill when that contents information is used can prevent effectively the wrong use using the billing information recording area provided on the same recording medium. Thus, both of the distribution of the pay contents information using the recording medium and the processing to bill therefor can be carried out satisfactorily.

[0049] According to the recording medium of the fifth aspect of the present invention, the recording method of the tenth aspect of the present invention which is applied to this recording medium, and the recording apparatus of the fifteenth aspect of the present invention in which the recording medium is installed, because the billing information contains the log information on utilization being an object of billing, information on conditions of utilization to be the object of billing is simultaneously recorded, so that a history of the utilization or the like can be seen from this log information and at the same time the utilization conditions can be later analyzed based on the recorded log information, thus allowing the wrong use to be prevented more effectively.

[0050] Having described preferred embodiments of the present invention with reference to the accompanying drawings, it is to be understood that the present invention is not limited to the above-mentioned embodiments and that various changes and modifications can be effected therein by one skilled in the art without departing from the spirit or scope of the present invention as defined in the appended claims.

Claims

1. A recording medium (1) having a write-once recording area in which any information can be recorded, but the recorded information cannot be rewritten, comprising

a billing information recording area in which the billing information is sequentially once recorded, on a partial area of said write-once recording area.

2. A recording medium (1) according to Claim 1, wherein

said billing information is information on a balance which reduces by the billing from an amount of money initially set up.

3. A recording medium (1) according to Claim 2, wherein

said billing information recording area is comprised of a predetermined number of blocks and a number of blocks on which said billing information is not yet recorded has a certain relation with said balance.

4. A recording medium (1) according to Claim 1, comprising

a contents information recording area on which contents information forming an object of billing of said billing information is previously recorded.

5. A recording medium (1) according to Claim 1, wherein

said billing information contains log information on utilization forming an object of billing.

6. A recording method for a recording medium having a write-once recording area in which any information can be recorded, but the recorded information cannot be rewritten, comprising the steps of estimating (6, 11) a partial area of said write-once recording area to be a billing information recording area for recording the billing information, and

processing (11, 14) to record sequentially once said billing information on the estimated area.

7. A recording method according to Claim 6, wherein

said billing information processed to record is information on a balance which reduces by the billing from an amount of money initially set up.

8. A recording method according to Claim 7, wherein

said balance is estimated from a number of non-recorded blocks in the area estimated to be said billing information recording area, and when the estimated balance is spent, a number

of blocks corresponding to the spent amount of money is recorded.

9. A recording method according to Claim 6, comprising the step of

processing (5) to reproduce contents information which is recorded on other area of the same recording medium (1) when said billing information is recorded (9) on said billing information recording area.

10. A recording method according to Claim 6, comprising the step of

recording log information on utilization forming an object of billing on said billing information recording area in said processing.

11. A recording apparatus, comprising

an estimating section (6, 11) for estimating a billing information recording provided in a write-once recording area in which recorded information cannot be rewritten from an installed recording medium (1) and a recording section (9, 14) for recording sequentially once said billing information on a nonrecorded portion of the billing information recording area estimated by said estimating section.

12. A recording apparatus according to Claim 11, wherein

said billing information which is recorded by said recording section is information on a balance which reduces by the billing from an amount of spent money initially set up.

13. A recording apparatus according to Claim 12, wherein

said estimating section estimates the balance from a number of nonrecorded blocks in the area which is estimated to be said billing information recording area by said estimating section, and said recording section, when processing to spend the estimated balance is carried out, processes to record a number of blocks corresponding to the spent amount of money.

14. A recording apparatus according to Claim 11, comprising

a reproducing section (5) for reproducing contents information which is recorded on other

area of the same recording medium when said recording section records (9) said billing information on said billing information recording area.

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15. A recording apparatus according to Claim 11, wherein

said billing information recorded by said recording section contains log information on utilization forming an object of billing.

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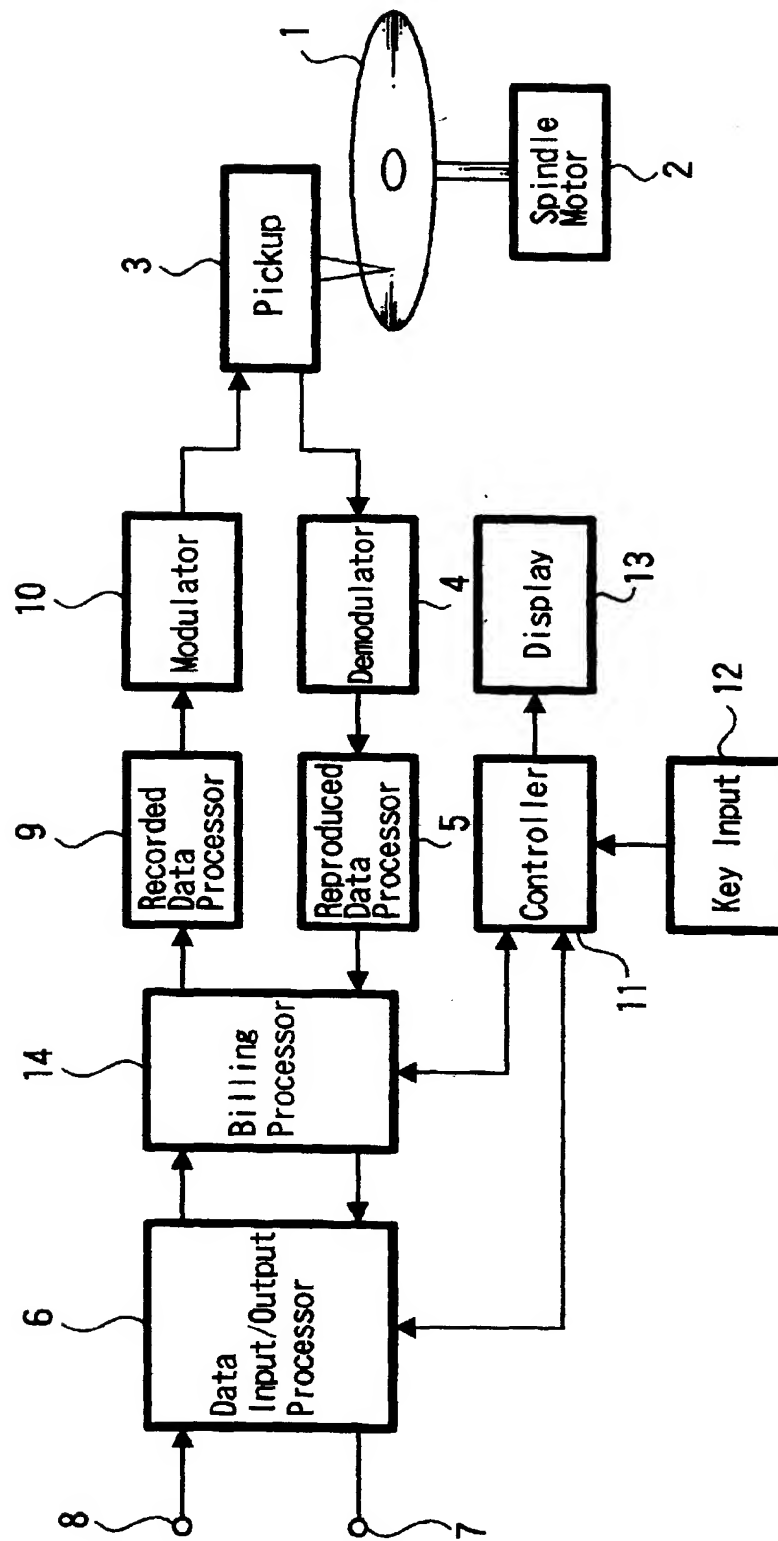
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FIG. 1



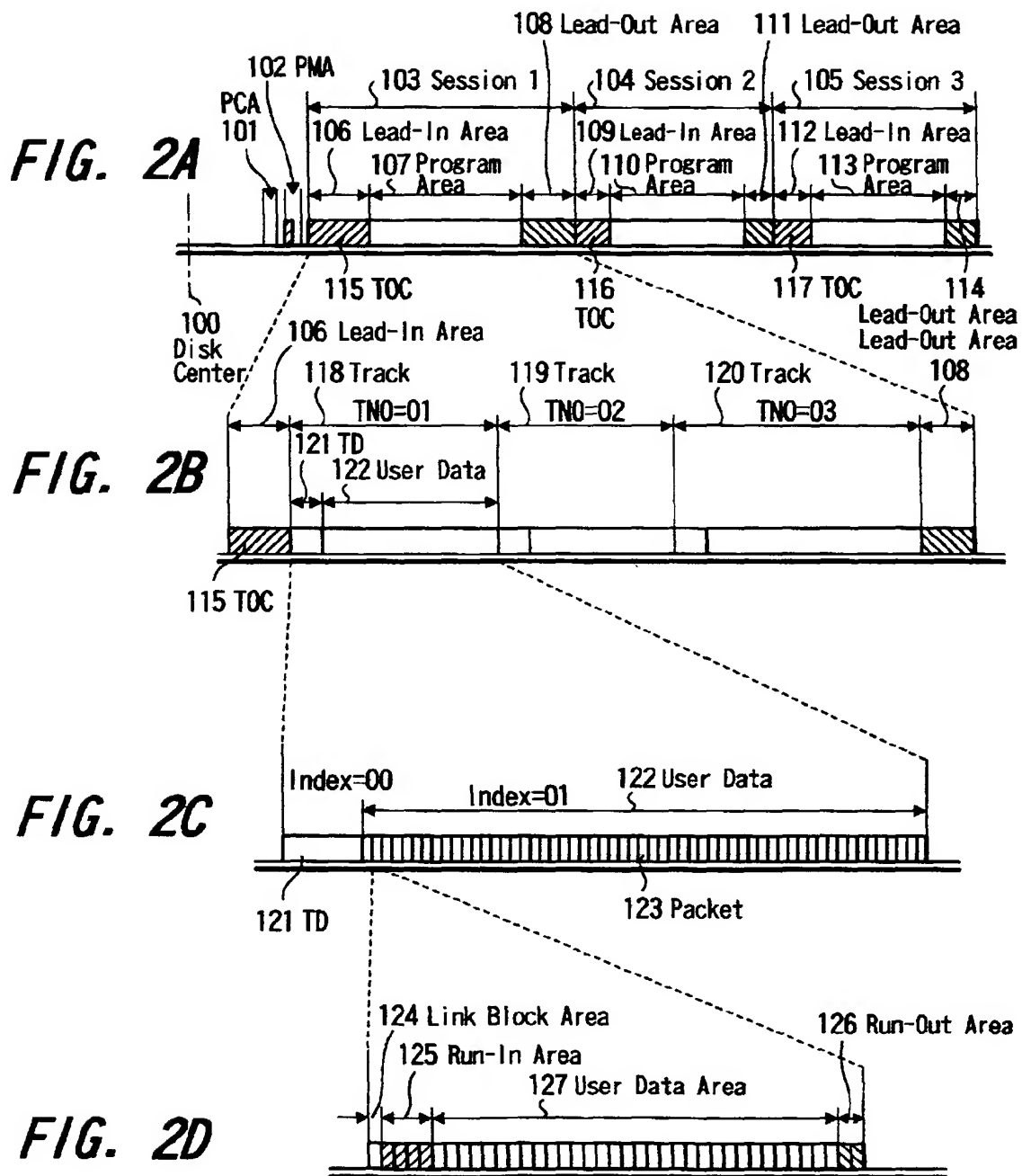


FIG. 3

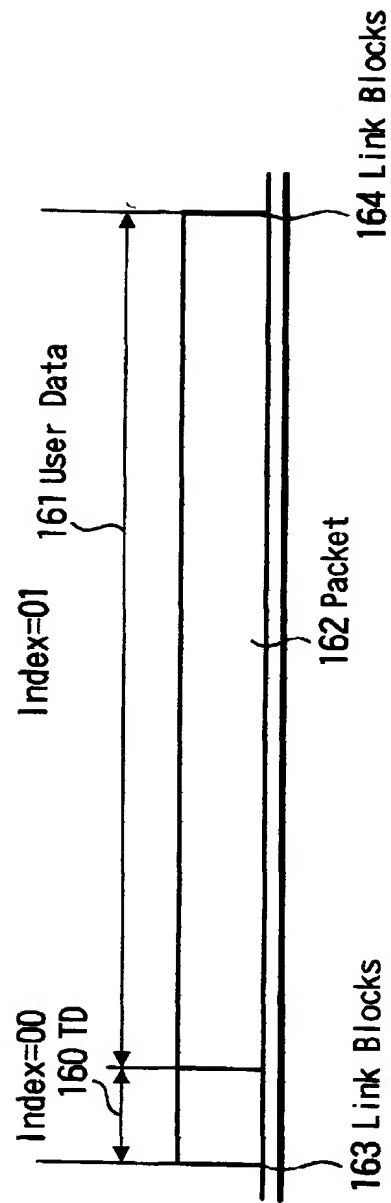


FIG. 4

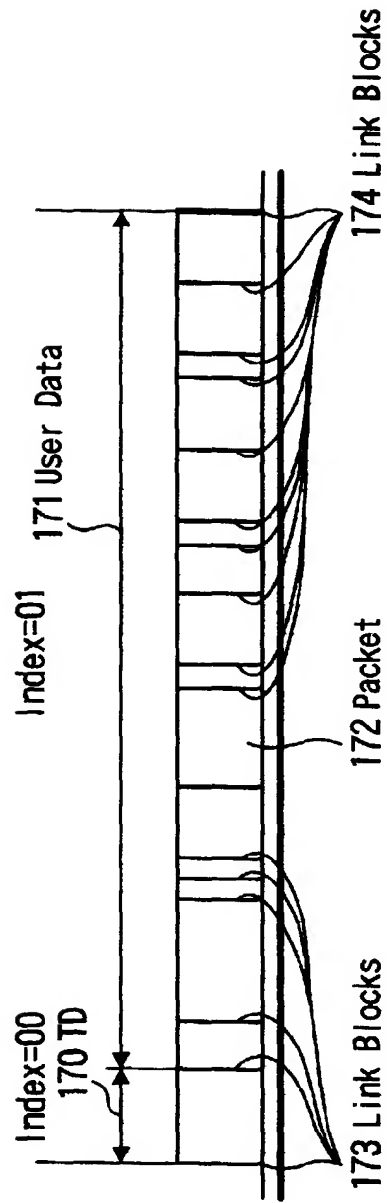


FIG. 5

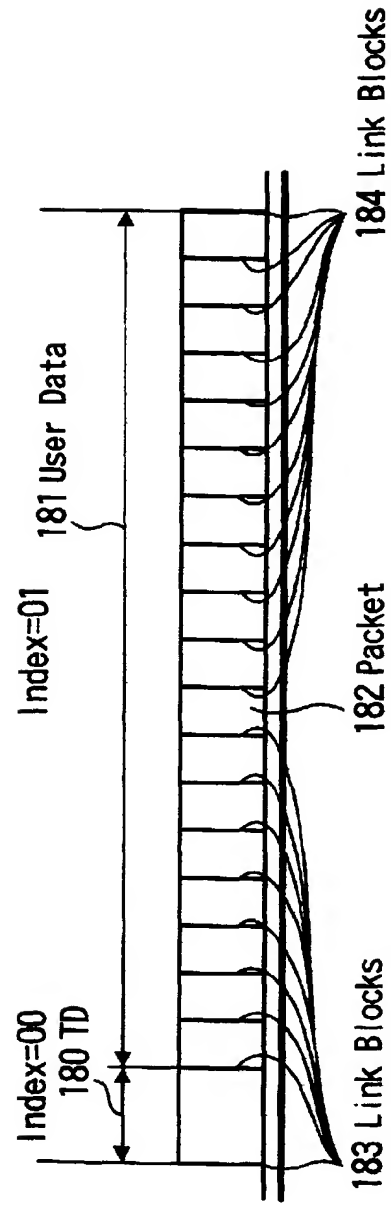
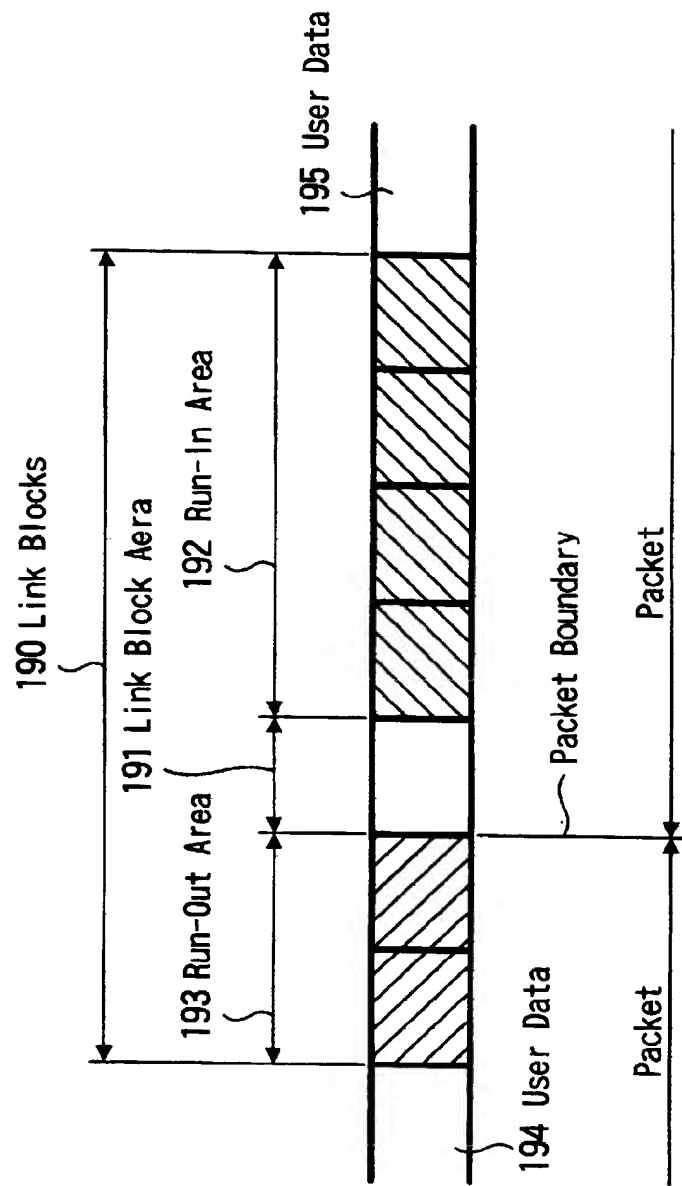


FIG. 6



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 99 11 8542

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 05, 30 May 1997 (1997-05-30) & JP 09 007039 A (KAIJO CORP), 10 January 1997 (1997-01-10) * abstract *	1,2,6,7, 11,12	G11B20/00 G11B20/12 G06F1/00 G06F17/30 G07G1/00 G07F7/02
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